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Electro Scientific Industries

13900 N.W. SCIENCE PARK DRIVE · PORTLAND, OREGON 97229

BRIDGES AND ACCESSORIES

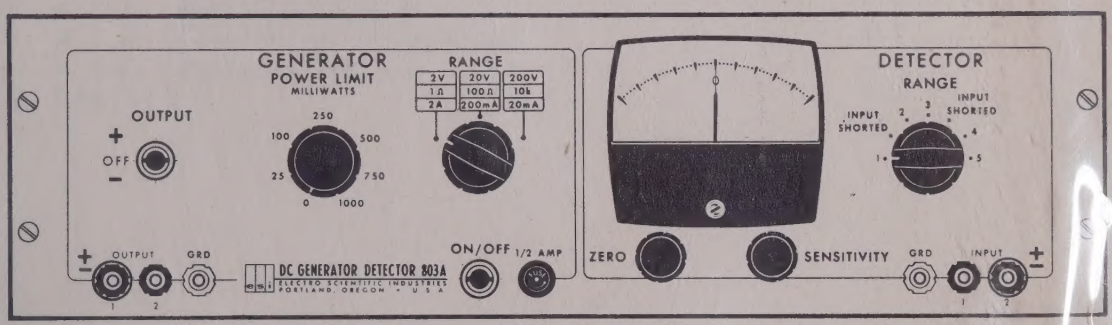
SEPTEMBER 1966

MODEL

803A

Instruction Manual

DC GENERATOR DETECTOR



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PVB® Potentiometric Voltmeter Bridge

SECTION I

INTRODUCTION

1.1 DESCRIPTION

The ESI® Model 803A is a dc generator and null detector. The generator features double-chassis construction for guarding that greatly reduces stray leakage paths to ground. Leakage from the high generator terminal (terminal 1) to ground has been completely eliminated. Insulation of the other terminal is kept to 10^{11} ohms or greater.

The output of the generator is continuously variable and is limited to a maximum of 1 watt into a matched load. A front panel control selects from three output ranges to match loads from 1 ohm to 10 kilohms.

The detector features a very sensitive modulator-type solid-state amplifier. Trouble caused by stray ac pickup from the device under test is greatly reduced by a rejection filter. The modulator operates substantially below the ac line frequency, thus further reducing the ac pickup. The detector is designed so that it may be operated with a floating input.

The unique design features of the Model 803A make it suitable for a number of applications:

1. Very high resistance bridge measurements can be made with superior accuracy because of the special guarding.
2. Low resistance bridge measurements can also be made with high accuracy because of the detector sensitivity and the provision for matching the generator to the load.
3. The same features apply to make the Model 803A an ideal generator-detector combination for calibrating precision voltage dividers. See Section 2.4 of this manual.
4. The Model 803A generator can be used separately wherever a variable, guarded, and power-limited dc supply is needed.

1.2 SPECIFICATIONS

1.2.1 Generator

Range: 3, 2 to 200 V. Power limited to 1 watt.

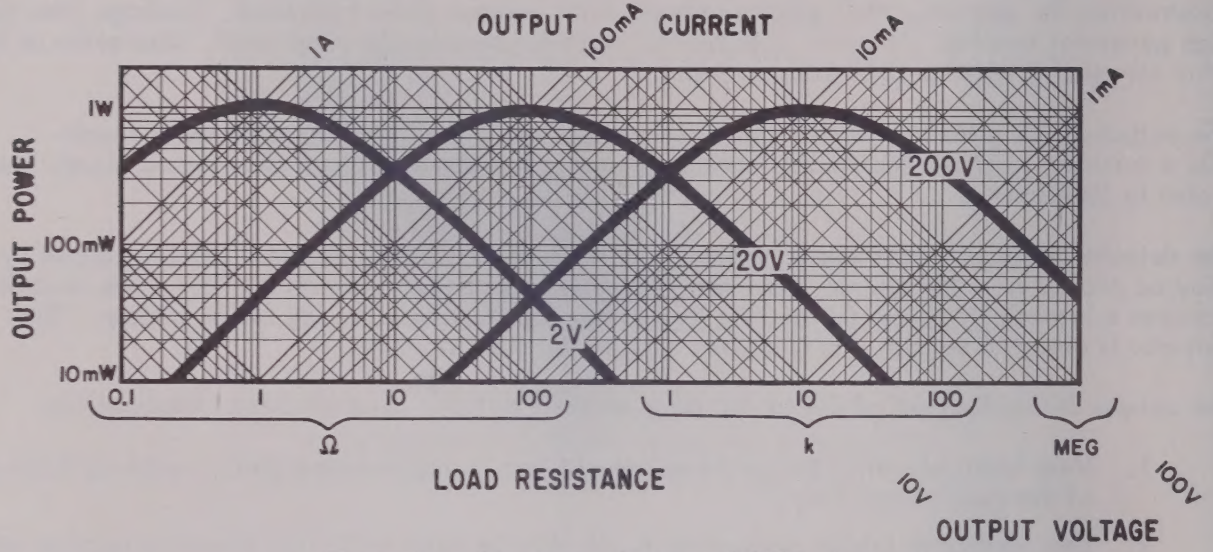

Figure 1-1 Maximum Output of 803A Generator

Resistance To Chassis: Guarded terminal 1 greater than 10^{14} ohms; Guard terminal 2 greater than 10^{11} ohms.

Output Values:

Open Circuit Voltage (Volts)	2	20	20
Short Circuit Current (mA)	2,000	200	20
Output Resistance (Ohms)	1	100	10k

1.2.2 Null Detector

Minimum Detectable Signal: 5 microvolts or better.

Input Resistance: Greater than 500 kilohms.

Zero Stability: ±5 microvolts or better long term.

AC Rejection: At least 70 db at 50 cps improving at all higher frequencies.

Ranges: A seven-position switch provides five decade sensitivity ranges and two input-shorting positions.

Sensitivity: Continuously variable through 80 db on each sensitivity range.

Zero Suppression: Zero suppression control provides up to ±300 microvolts to offset externally produced thermal voltages.

Overload Recovery Time: Full-scale deflection recovery within 3 seconds. Recovery within 5 seconds for overloads of 10,000 times minimum

detectable signal. Recovery within 60 seconds for overloads of 100 million times minimum detectable signal.

Source Impedance: No zero shift or damping response change from short circuit to open circuit conditions.

Stabilization Time: Sixty seconds or less after switching on.

Resistance To Chassis: Guard terminal 1 greater than 10^{11} ohms; Guarded terminal 2 greater than 10^{13} ohms.

1.2.3 Physical

Height: 5-1/4 inches.

Length: 19 inches.

Depth: 7 inches.

Weight: 10 lbs net.

Power requirements: 117 volts, 50 to 400 Hz (cps), 10 watts.

SECTION II

OPERATING INSTRUCTIONS

2.1 TERMINALS AND CONTROLS

ON/OFF switch controls line power to generator and detector.

OUTPUT terminals are used to connect the generator to an external circuit.

OUTPUT switch turns the generator on and selects generator output polarity.

DETECTOR RANGE switch provides five sensitivity ranges and two input-short-circuiting positions. Position 1 is the most sensitive and position 5 is the least sensitive. Note that there is one INPUT SHORTED position next to each sensitivity range except the least sensitive. This allows the input to be shorted from almost any range without switching through other ranges.

ZERO control adjusts the detector zero.

SENSITIVITY control provides approximately 80 db variation on each range.

INPUT terminals are used to connect the detector to an external circuit.

GENERATOR POWER LIMIT control varies the power output level of the generator from 0 to 1 watt maximum.

GENERATOR RANGE switch selects the generator output voltage and a matching limiting resistor.

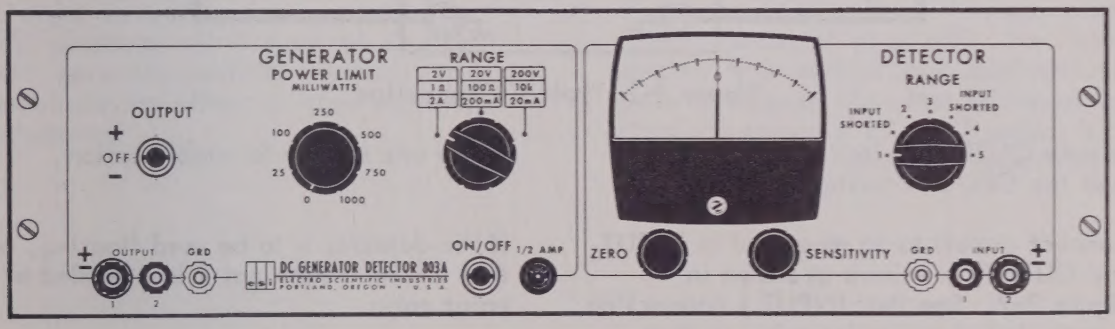

Figure 2-1 Model 803A, Panel View

2.2 BASIC OPERATING PROCEDURE

The basic operating procedure for the Model 803A to test or adjust any three-terminal or four-terminal resistive circuit is to apply the generator output to one pair of terminals and observe the resulting signal at another pair of terminals with the detector. The procedure is applicable both to null balance applications, such as bridge balancing and voltage divider calibration, and to meter deflection applications such as unbalanced bridge measurements.

Various specific applications are discussed in the manual. The basic operating procedure for all applications is as follows:

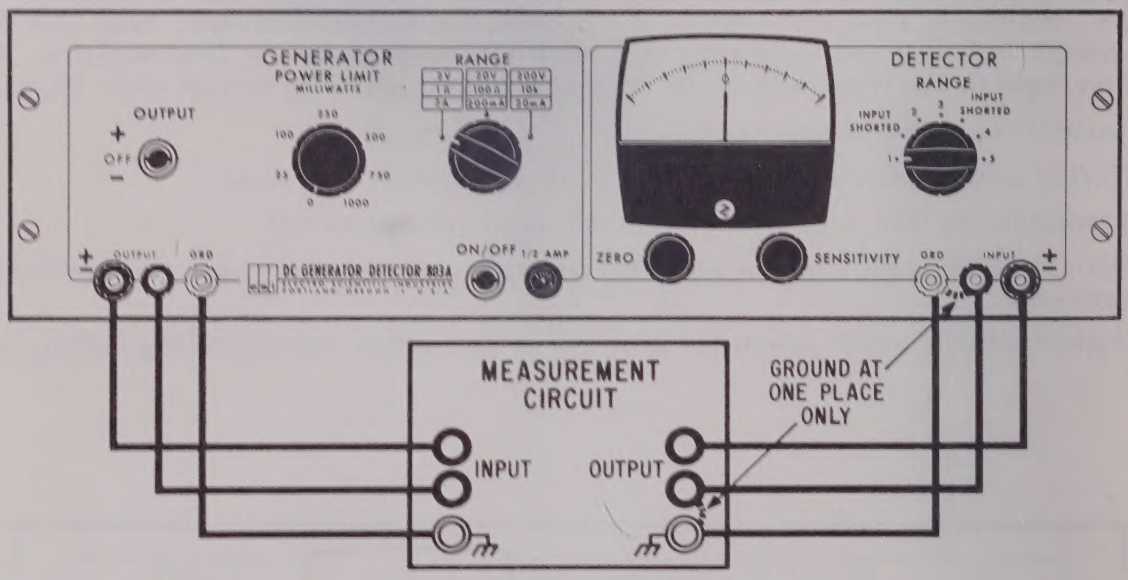

Figure 2-2 Typical Connection

1. Be sure OUTPUT switch is off, then push the ON/OFF switch to turn on.

   Allow one minute for stabilization.

2. Connect circuit to be measured to INPUT and OUTPUT terminals as shown in Figure 2-2. See that INPUT 1 connection is grounded at one point only, so that ground loop currents between chassis cannot flow through these leads.

   If the detector is to be used floating, see that OUTPUT terminal 2 is grounded at one point only.

3. Set DETECTOR RANGE switch to 1 and SENSITIVITY control to maximum gain (cw) and adjust ZERO control for detector zero.

   Always adjust zero with detector input connected to the measurement circuit - not open or short circuited - in order to cancel externally generated thermal voltage.

4. Turn DETECTOR RANGE control to 5.

   This will avoid meter recovery delays caused by input signals greater than full scale.

5. Set GENERATOR POWER LIMIT control to a value that will not cause resistance changes due to heating.	Experience and experiment will establish the proper setting. If there is a chance of damaging some component, use a low setting and increase the power only when it is apparent that there is not enough sensitivity. Under some conditions, it may be best to measure the voltage or current while the POWER LIMIT control is being increased.
6. Set GENERATOR RANGE control as desired.	At a setting approximately equal to the input resistance of the measurement circuit, the generator output will be maximum.
7. Turn generator on by setting OUTPUT switch to desired polarity; the marking indicates the polarity of OUTPUT terminal 1.	If large switching transients are evident, set DETECTOR RANGE switch to INPUT SHORTED position first then turn generator on. After allowing the transients sufficient time to die out return the RANGE switch to a numbered position.
8. Adjust GENERATOR RANGE control for maximum detector deflection with an unbalanced measurement circuit. Increase GENERATOR POWER LIMIT setting if necessary to obtain more sensitivity.	For very low power, adjust GENERATOR RANGE control for minimum detector deflection with an unbalanced measurement circuit.
9. Change SENSITIVITY and DETECTOR RANGE settings as required.	Turn off the OUTPUT switch and recheck detector ZERO adjustment each time the sensitivity is increased.
10. Take as the final meter reading the change in reading with generator on and generator off (or half the change with generator polarity reversal), to eliminate the effect of imperfect zero adjustment.	Take readings after switching transients have disappeared (normally within one second after turning generator on or off). For maximum sensitivity in null balance applications, generator power can often be increased for final adjustment if OUTPUT switch is left on only a few seconds at a time to minimize resistor heating.

2.3 USING THE 803A FOR BRIDGE MEASUREMENTS

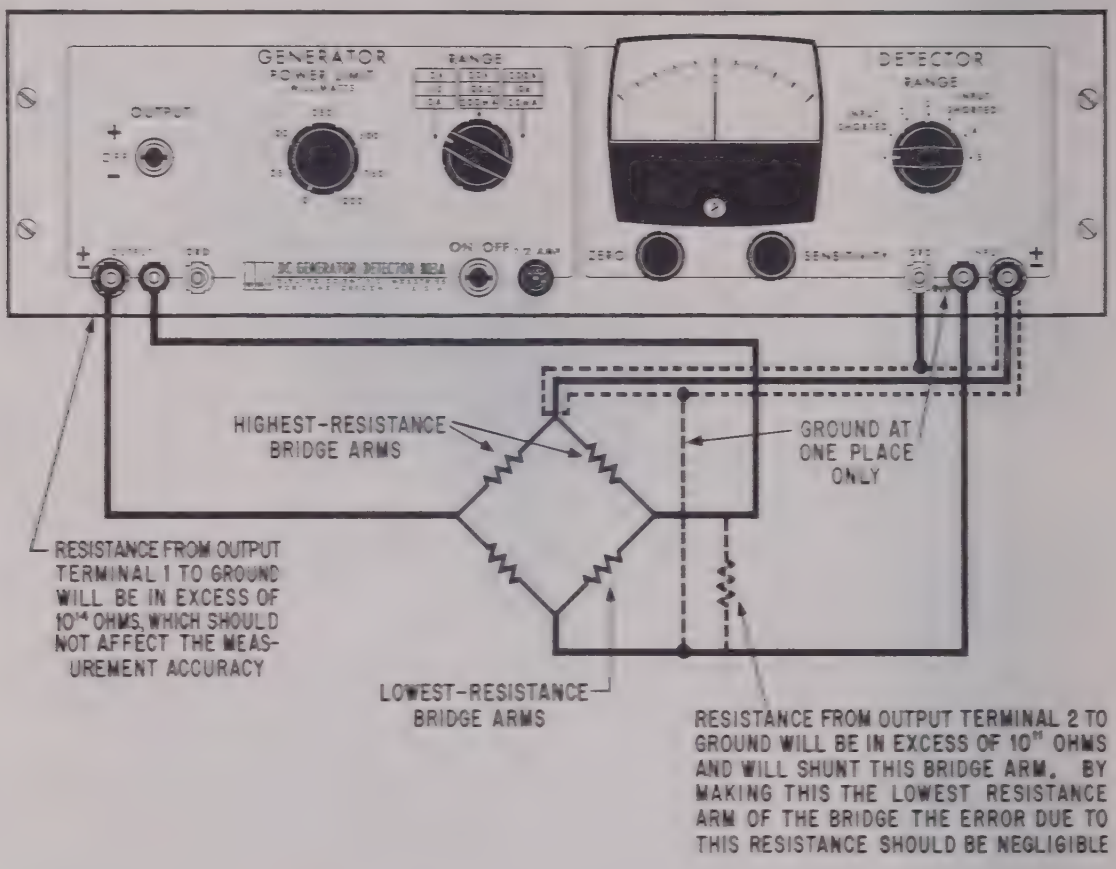
GENERATOR
RANGE
OUTPUT
DETECTOR
RANGE
ZERO
ON OFF
HIGHEST-RESISTANCE BRIDGE ARMS
GROUND AT ONE PLACE ONLY
RESISTANCE FROM OUTPUT TERMINAL 1 TO GROUND WILL BE IN EXCESS OF 10^{14} OHMS, WHICH SHOULD NOT AFFECT THE MEASUREMENT ACCURACY
LOWEST-RESISTANCE BRIDGE ARMS
RESISTANCE FROM OUTPUT TERMINAL 2 TO GROUND WILL BE IN EXCESS OF 10^{11} OHMS AND WILL SHUNT THIS BRIDGE ARM. BY MAKING THIS THE LOWEST RESISTANCE ARM OF THE BRIDGE THE ERROR DUE TO THIS RESISTANCE SHOULD BE NEGLIGIBLE

Figure 2-3 Bridge Connection

Connect the bridge to the INPUT and OUTPUT terminals as shown in Figure 2-3, then balance bridge following basic operating procedure of Section 2.2.

2.4 USING THE 803A FOR VOLTAGE DIVIDER CALIBRATION

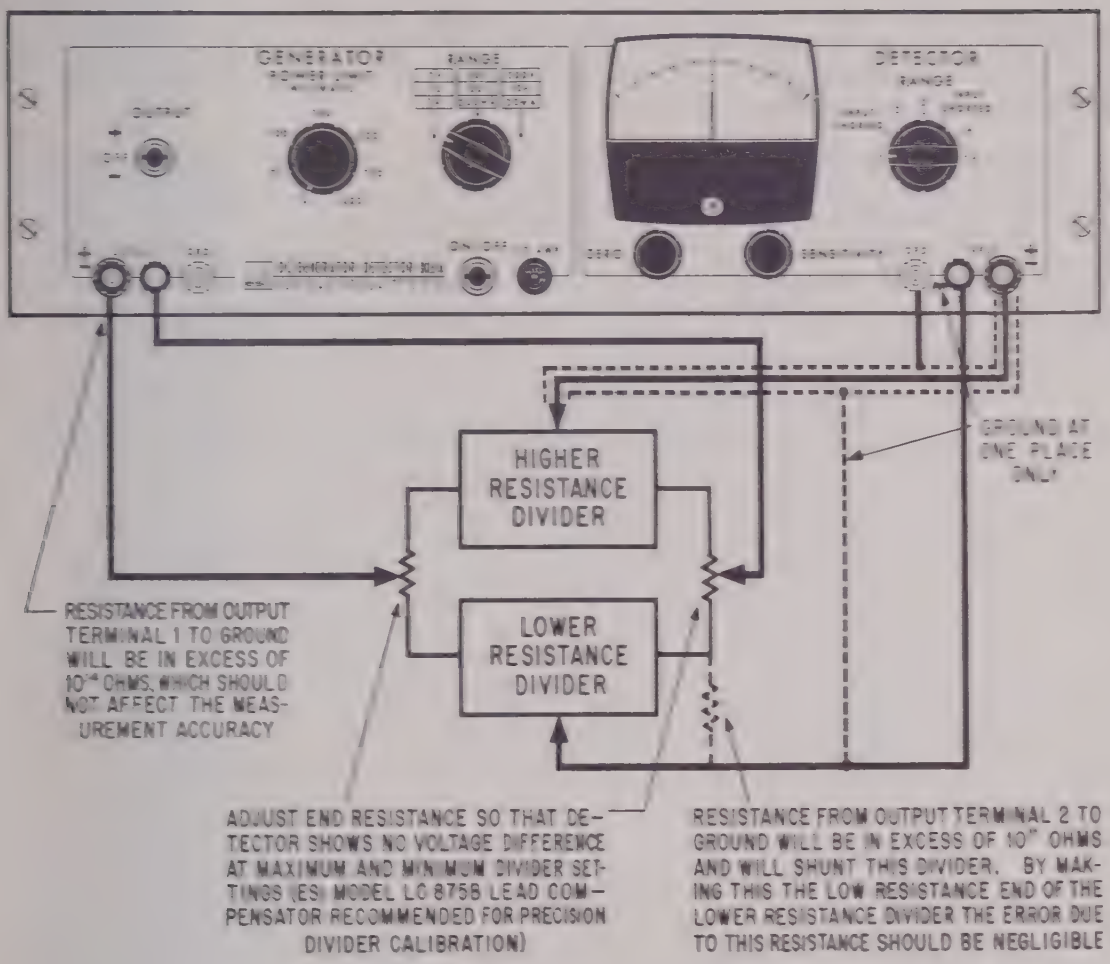
GENERATOR
RANGE
DETECTOR
RANGE
HIGHER RESISTANCE DIVIDER
LOWER RESISTANCE DIVIDER
GROUND AT ONE PLACE ONLY
RESISTANCE FROM OUTPUT TERMINAL 1 TO GROUND WILL BE IN EXCESS OF 10^14 OHMS, WHICH SHOULD NOT AFFECT THE MEASUREMENT ACCURACY
ADJUST END RESISTANCE SO THAT DETECTOR SHOWS NO VOLTAGE DIFFERENCE AT MAXIMUM AND MINIMUM DIVIDER SETTINGS (ESI MODEL LC 875B LEAD COMPENSATOR RECOMMENDED FOR PRECISION DIVIDER CALIBRATION)
RESISTANCE FROM OUTPUT TERMINAL 2 TO GROUND WILL BE IN EXCESS OF 10^11 OHMS AND WILL SHUNT THIS DIVIDER. BY MAKING THIS THE LOW RESISTANCE END OF THE LOWER RESISTANCE DIVIDER THE ERROR DUE TO THIS RESISTANCE SHOULD BE NEGLIGIBLE

Figure 2-4 Voltage Divider Connection

Connect the pair of dividers or attenuators to the INPUT and OUTPUT terminals as shown in Figure 2-5, then adjust to find pairs of settings giving detector null indications, following the basic operating procedure of Section 2.2.

The generator is line-operated. A continuously variable auto-transformer feeds a tapped-secondary power transformer, which in turn supplies a rectifier and filter network. The filtered dc is supplied to the output terminals through various resistance combinations. These combinations, plus tapped secondary rectifier combinations, are controlled by the GENERATOR RANGE switch on the front panel and make it possible for the generator output to match most load resistances. They also limit the output power to one watt. Figure 3-2 is a schematic diagram of the generator.

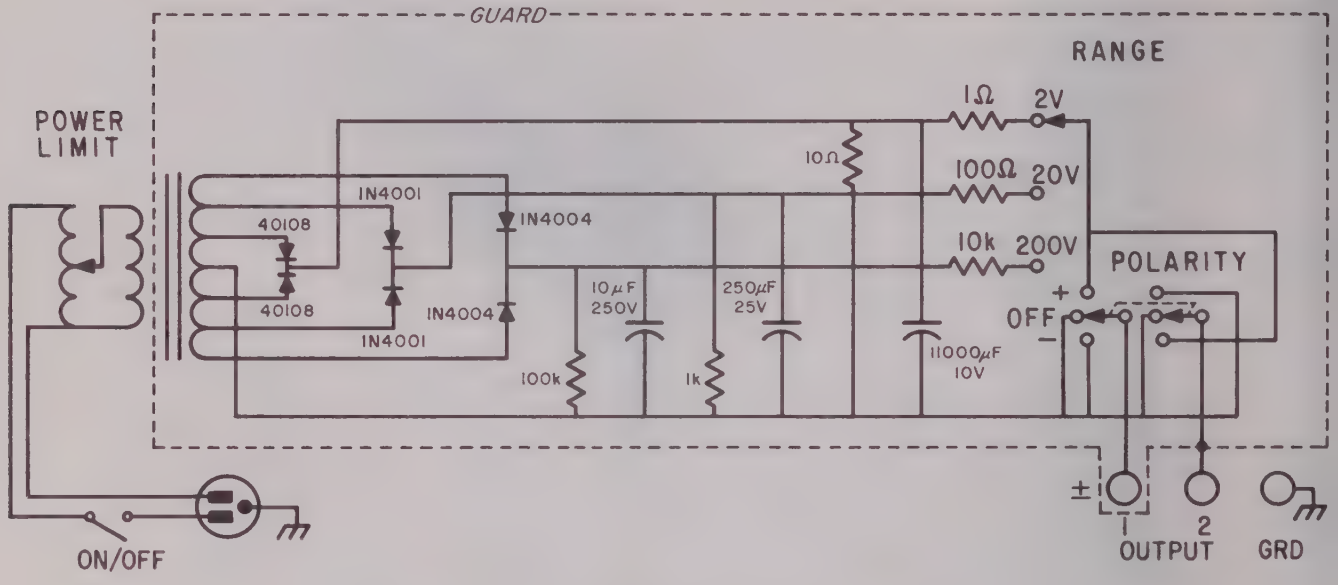

Figure 3-2 Generator, Schematic Diagram

3.2 DETECTOR

The Model 803A detector is a modulator-type dc null detector with integral high-gain solid-state amplifier. The input signal passes through a low-pass filter to reduce unwanted ac pickup. A modulator converts the filtered dc to a square wave. This signal is amplified by a high-gain ac amplifier and a demodulator synchronized to the modulator converts the amplifier output to dc. Figure 3-3 is a simplified schematic of the detector.

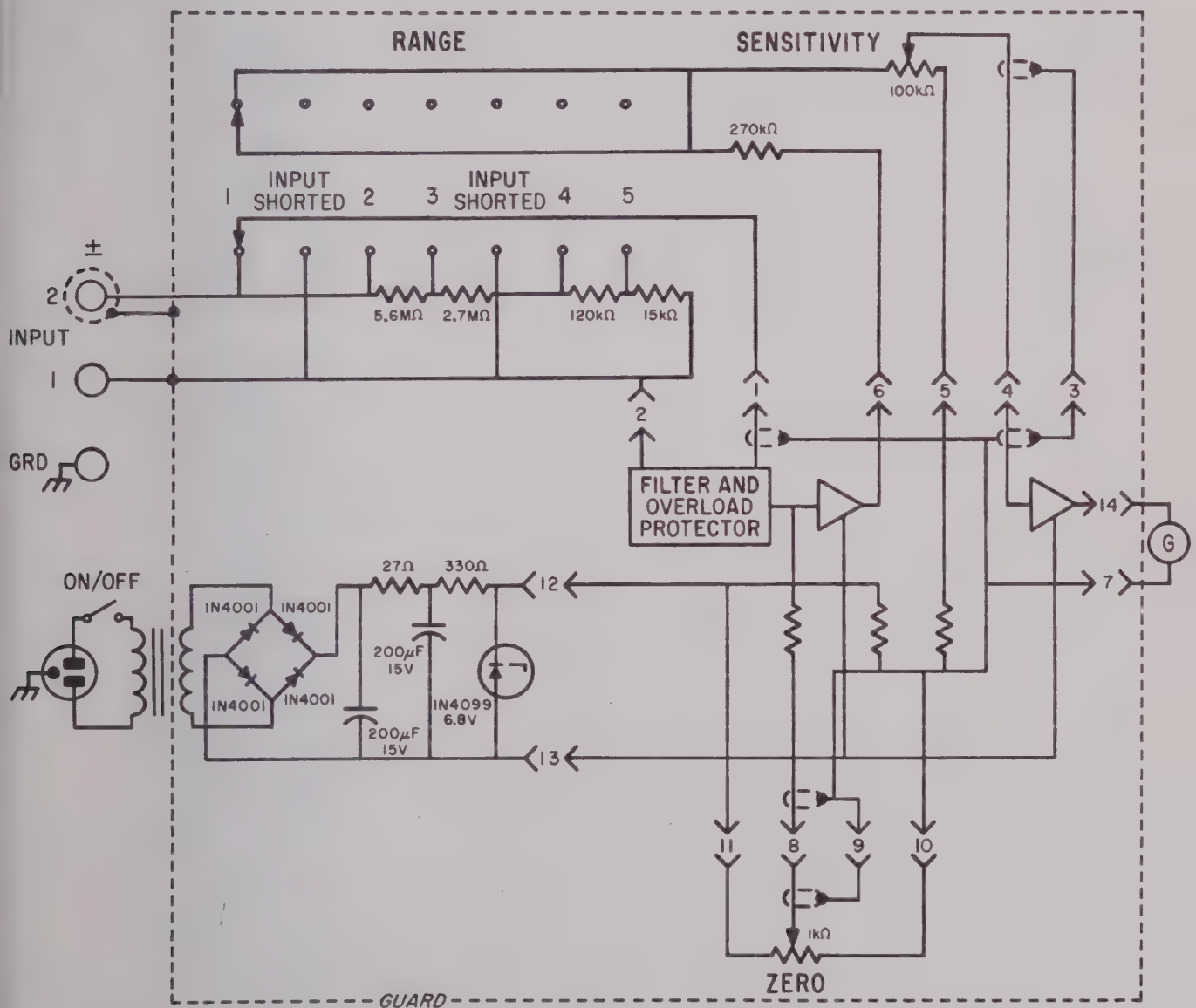

Figure 3-3 Detector, Simplified Schematic Diagram

SECTION IV

MAINTENANCE

4.1 PREVENTIVE MAINTENANCE

The following procedures should be performed periodically (approximately once a year) to insure maximum reliability from the Model 803A Generator-Detector.

If the need for major repairs is apparent, it is recommended that the unit be sent to the factory for service. The service department will be glad to furnish the necessary information for repairs as well as any replacement parts. However, unauthorized repairs will invalidate the instrument warranty. If the instrument is more than two years old when returned to the factory, a reasonable charge may be expected for replacement of parts or complete reconditioning.

4.1.1 Visual Inspection

Inspect the unit for dial orientation and damage to binding posts and binding post caps. Also check for dirt around the binding post insulators. Then remove the case as described in Paragraph 4.1.2 and inspect the unit for possible internal defects. These defects include such things as loose or broken connections, damaged or dirty switch contacts, and heat-damaged resistors.

4.1.2 Removing the Case

Prepare a soft, clean place to set the instrument. Be sure that no projections or pointed objects will be underneath the panel. See that there are no metal filings in the area.

Place the unit face down on the prepared surface. Loosen the screws on the back of the instrument and carefully slide the case off.

4.1.3 Cleaning and Lubrication

Clean the front panel with a soft, dry, lint-free cloth, being particularly careful to remove all dirt from around the binding post insulators. The only internal components that require cleaning and lubrication are the switches.

The switches are carefully lubricated at the time of manufacture and are protected from contamination by the instrument case. They should rarely, if ever, require maintenance. It is recommended that they be cleaned or lubricated only if it is determined that they are not making good electrical contact. If the switch decks are in need of cleaning or lubrication proceed as follows:

a) Apply solvent (Freon printed circuit solvent or equivalent) to the contact surfaces with a small brush or pipe cleaner.

b) Wipe surfaces with clean, dry brush or dry with low pressure air.

c) Apply a thin coating of lubricant (Oak #2008 or equivalent) to the contact surfaces with a hypodermic needle.

d) Apply two drops of the same oil to each of the switch bearings and detent mechanisms.

e) Remove excess oil with a clean, dry cloth and remove all traces of lint with a soft brush.

4.1.4 Replacing the Case

Be sure that the interior of the case is completely clear of all foreign material. Slip the case over the unit and replace the screws.

4.2 PARTS LIST

The following parts are listed alphabetically by description of part or major assembly. Parts of each major assembly are indented and listed alphabetically within each grouping. All parts are available from Electro Scientific Industries, Inc.

The Federal Supply Code for Manufacturers (FSC) for Electro Scientific Industries is 11837.

When ordering parts, please include the following information:

Model and serial number of the instrument
ESI part number
Description of part

DESCRIPTION	PART NO.	QTY USED
Binding Post	1396	4
Binding Post, Guarded	1480	2
Cap, Binding Post, Gold-Plated	1172	2
Cap, Binding Post, Insulated Black	1170	4
Coupling, Shaft, Flexible	8053	1
Detector Assembly[1]	6495	1
Dust Cover	18025	1
Front Panel	18005	1
Fuse, 1/2 amp, Slo-Blo, 3 AG	1810	1
Fuse Holder	3074	1
Insulator, Guarded Binding Post, Stepped Diameter	1482	2
Knob, Small Bar, Filled	1270	1
Knob, Small Round, Filled	1268	3
Knob for Toggle Switch	6875	1
Meter	18007	1
Insulator, Meter Mounting	5101	6
Pilot Light and Switch	18036	1
Plug, 14 Pin Amphenol	15731	1
Potentiometer, Linear 1kΩ, Zero	6577	1
Potentiometer, Logrithmic, 100kΩ Sensitivity	6576	1
Power Cord	2520	1
Printed Circuit Board Assembly, Detector	18019	1
Consisting of:		
Resistor, 330Ω, 10%, 1/2 watt	2025	1
Resistor, 27Ω, 10%, 1/2 watt	2044	1
Capacitor, 20μF, 15V	15838	2
Diode, Zener, 6.8V, 5%, 0.3 watt Type 1N4009 or equivalent	1780	1
Diode, Type 1N4001	1785	4
Printed Circuit Board, Detector	18009	1

[1] Trade-in allowance for defective detector assembly.

DESCRIPTION	PART NO.	QTY USED
Printed Circuit Board Assembly, Generator	18018	1
Consisting of:		
Resistor, 10kΩ, 10%, 5 watts	1991	1
Resistor, 100kΩ, 10%, 1/2 watt	1963	1
Resistor, 100Ω, 10%, 5 watts	1990	1
Resistor, 1kΩ, 10%, 1/2 watt	1969	1
Resistor, 0.47Ω, 10%, 2 watts	1789	1
Resistor, 10Ω, 10%, 1/2 watt	2039	1
Diode, 1N4004	1786	2
Diode, 1N4001	1785	2
Diode, Type 40108	1787	2
Capacitor, 10μF, 250V.	1913	1
Capacitor, 250μF, 25V.	1790	1
Capacitor, 11,000μF	1788	1
Printed Circuit Board	18008	1
Resistor, 47kΩ, 10%, 1/2 watt	1958	1
Shoulder Washer for Ground Binding Post of Guarded Group	2245	4
Shoulder Washer for Guarded Binding Post	7725	2
Sleeve, Guarded Binding Post	1481	2
Support Plate, Guarded Binding Post	18029	2
Switch Contact Assembly, Guarded, Generator Polarity	18024	1
Switch Lever & Bushing, Generator Polarity	18023	1
Switch, Detector Shorting	6599	1
Switch, Generator, Impedance	8020	1
Transformer, Power, Detector	18022	1
Transformer, Power, Generator	18021	1
Transformer, Variable	8068	1
Washer, Binding Post	8823	4

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Electro Scientific Industries, Inc. maintains reference standards of measurement which are compared with the U. S. National Standards through frequent tests by the U. S. National Bureau of Standards.

ESI working standards and testing apparatus used are calibrated against the ESI reference standards in a rigorously maintained program of measurement control.

The manufacture and final calibration of all ESI instruments are controlled by use of the ESI reference and working standards and testing apparatus in accordance with established procedures and documented results. (Reference MIL-C-45662)

Final calibration of this instrument was performed with reference to the mean values of the ESI reference standards or to ratio devices that were verified at the time and place of use.

Would you like more information?

There is a complete bibliography of ESI technical publications on the opposite side of this page. Underline the titles or order numbers of any publications you would like us to send. If there is any information that you would like to have, or if there is any comment you would like to make concerning the instrument or instruction manual, please fill out this page.

Instrument Description: Model No. _____ Serial No. _____
(Please Print)

Name _____ Title _____

Department _____ Mail Stop _____

Company _____

Address _____

City _____ State _____ Zip Code _____

Any comments or corrections? _____

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